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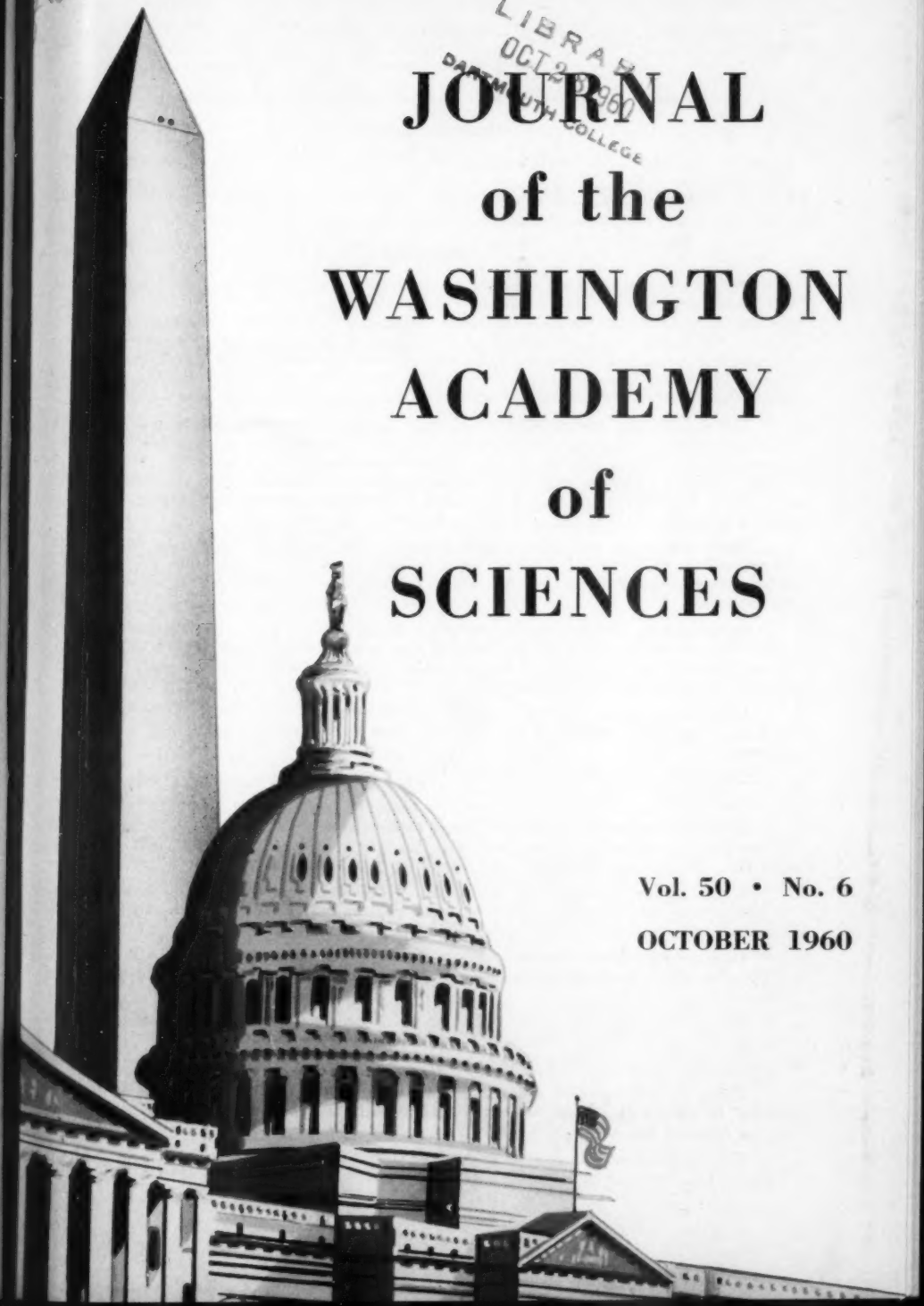
# JOURNAL of the WASHINGTON ACADEMY of SCIENCES



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# JOURNAL OF THE WASHINGTON ACADEMY OF SCIENCES

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# The Magnetic Field Accompanying Neuronal Activity
# A New Method for The Study of The Nervous System

JOHN H. SEIPEL * AND ROBERT D. MORROW * *

## Introduction

From the time of Galvani and Volta it has been accepted that electrical activity is associated with the transmission of information by the nervous system; in its ultimate form this activity consists of separate electrical impulses conducted by neurons. The neurophysiological literature, reflecting currently accepted methods and procedures for research in this field, describes much work measuring neuronal activity by direct electrode implantation and other procedures. While these methods have been highly developed they carry certain inherent limitations and inaccuracies; the most advanced of these methods carry additionally a high degree of technical difficulty precluding their use in many laboratories. Further, as is true for any experimental method, information may be obtained only within the scope of the quantities measureable; extension of a method to the investigation of other parameters is rarely accomplished without great difficulty. In discussing the various methods of neurophysiological research the authors concluded that a new approach to the investigation of neuronal activity was indicated. It was hoped that a method might be found that would be technically simple, accessible to all investigators, and capable of extension to the determination of quantities hitherto measured indirectly.

Since the time of Maxwell it is a recognized physical fact that an inductive field having both electromagnetic and electrostatic components is associated with the movement of charged particles, i.e., electrical activity. These fields are directly and rigorously dependent upon the underlying electrical activity; measurement of such magnetic fields gives a precise and complete determination of the quantity and direction of the underlying activity.

Hitherto overlooked as a possible approach to the investigation of neuronal electrical activity, intuitively such a field should be present and, with proper apparatus, be measureable (Figure 1).

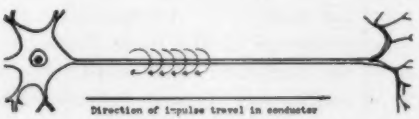


*Fig. 1. The magnetic field surrounding a conductor*

In an extensive search of the literature many publications were found that discussed various bioelectric fields and their effects, but only one, that of Burr and Mauro,[1] draws the important and basic distinction between an electrical field, such as exists in a potential gradient between two electrodes in a conducting solution or surrounding a conductor in an ionic medium, and the inductive field generated by elec-

* Laboratory of Experimental Neurology, Dept. of Neurology, Georgetown University Medical School, Washington, D. C.

** 6324 Hazelwood Ave., Baltimore 6, Md.

[1] Burr, H. S., and Mauro, A., Yale J. Biol. Med., *21*, 457-462 (1949)

trical activity. In this paper the authors detected and measured the electrostatic field about a stimulated frog sciatic nerve and found it extended to at least 12 mm. in air from the nerve, varying from 550 microvolts at the nerve to 150 microvolts at 12 mm. These observations were then compared with values calculated using the equations of Lorente de No[2] and were found to be in close agreement. It is apparent, however, that Lorente de No in his derivation used the Maxwellian equations transformed for fields in volume conductors rather than for general inductive fields.

Neither in the above cited papers or elsewhere in the literature is there a reference to the magnetic component of the field accompanying the electrical activity of the neuron.

Theoretical considerations indicate that a magnetic field is relatively unaffected by its surroundings and is shielded only by ferromagnetic materials; a method of detection of neuronal activity based upon magnetic methods would be almost independent of the tissues surrounding the nerve and, with proper instrumentation, the ionic properties of the tissue fluids. In short, the magnetoneuronal activity should be detectable at a distance, perhaps even beyond the skin of an intact subject.

## Experimental

### *Apparatus*

For these qualitative attempts at detection of the neuronal field a DuMont Model 304A oscilloscope was modified by use of carefully selected high-gain vertical amplifier tubes and metallic shielding of its input terminals; both chassis and case were grounded directly to an earth ground. An unmodified Weston Model 983 oscilloscope was used when simultaneous direct recording of the electrical impulse was necessary.

A Grass Model 3C stimulator was used with carefully shielded leads and was calibrated against the DuMont oscilloscope. This unit was connected to earth ground.

Because of stray fields and their interfering noise it was found necessary to place a direct ground post through the floor extending 6′ below the lowest level of the building; *all* electrical equipment in the room, including lights, refrigerator, soldering irons, and the various units of the apparatus described in this paper were connected by heavy soldered ground straps to this post.

Detection of the magnetic field was accomplished using detector heads of various designs. Basically these heads consisted of one or more highly compact series-wound coils of ultra-fine copper wire and differed only in the presence or absence of steel or other metallic shielding and in the presence or absence of ferrite cores within the coils. The steel shielding was most effective in blanking extraneous noise; in this case the coil protruded slightly less than half of its diameter in the direction of the nerve. The ferrite made no measureable difference in the sensitivity of the coil. The coils measured 2mm. x 3 mm. x 6 mm. and contained approximately 3000 turns of copper wire; they were completely insulated in plastic tape and potted. The heads were mounted on a rack and pinion arm graduated in millimeters and could be positioned at various distances from the nerve and at various axis positions relative to the nerve. When used, shielding was carefully connected to earth grounding.

Signals from the detector were amplified by a self-contained battery-operated two-stage resistance-coupled preamplifier using a selected noise-free 6SC7 tube. The entire preamplifier was contained with the experimental subject in a specially constructed electrostatically shielded aluminum apparatus. The output from this amp-

[2] Lorente de No, R., Stud. Rockefeller Inst. Med. Res., #131 and 132 (1947)

lifier was led directly to the DuMont oscilloscope.

All connecting leads within the above apparatus were doubly shielded; all other leads were singly shielded.

Permanent recordings were taken by Polaroid land camera, on tape using a specially designed Product Development Associates Mark I dual channel medical tape recorder, and on 16 mm. motion picture film.

Synchronization was run to the AC line to give as stable a base line as could be obtained.

*Procedure*

The sciatic nerve of the American bullfrog. R. catesbiana, was chosen for study as it is easily obtained and has been exhaustively studied by classical methods.[2] Selected jumbo bullfrogs were pithed and their sciatic nerves freed from the spinal column to the gastrocnemius muscle, ligating vessels and severing twigs where necessary; other nerves to the thigh muscles were severed to prevent as much movement as possible during stimulation. Isolated nerves were prepared according to the method of Lorente de No.[2] The frog was mounted on a dissecting tray with the copper screen ground electrode for the electrical readout between the frog and the wax; the thigh muscles were pinned back exposing the nerve. The tray was inserted in the apparatus case and connected to ground within the case. The nerve was suspended between the stimulator electrode hooks and the copper wire electrode for electrical impulse detection. The magnetic detector was placed at various distances from the stimulator electrodes and before the electrical readout electrode with approximately ½ to 1 mm. air gap from the coil to the nerve. The nerve was moistened as necessary with Ringer's solution.

Stimulus was applied at a level sufficient to give a maximum electrical action pulse but was not increased above this level. This stimulus varied with each nerve but was usually initially about .7-.9 volts for 1 millisecond at a frequency of 50-70 per second.

Isolated nerves were suspended in a plexiglass constant humidity chamber containing Ringer's solution. These nerves were stimulated electrically or by mechanical crushing. In the latter case determinations were made both with the electrical pickup electrodes contacting the nerve and with no connections of any sort in the apparatus except the electromagnetic detector coil.

**Results**

The directly recorded electrical action potentials are equivalent to those in the literature.[2, 3]

A composite tracing typical of the electromagnetic component of the action pulse is shown in Figure 2.

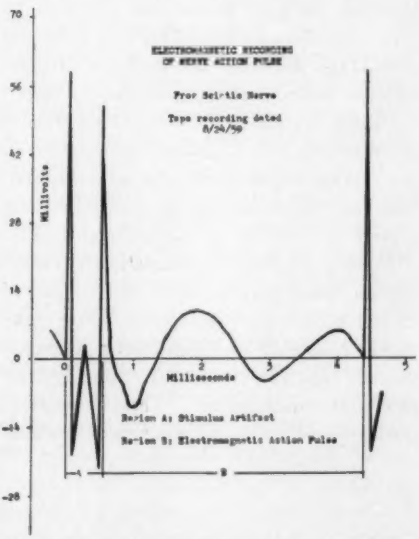


*Fig. 2. Composite tracing of the electromagnetic action pulse*

[3] Erlanger, J., and Gasser, H. S., "Electrical Signs of Nervous Activity," University of Pennsylvania Press, Philadelphia, 1937

The scale in millivolts is the value observed on the oscilloscope; since the detection and amplification equipment were uncalibrated the relationship of these values to the input signal is unknown.

Placement of the magnetic detector at varying distances from the stimulator electrodes gave the expected variable delay of the electromagnetic trace following the stimulus artifact and showed the same time lag as the electrical pulse when the electrical pickup was in the same position.

As the nerves gradually died or became refractory to stimulation the decrease in amplitude of the electrically observed pulse paralleled that of the electromagnetically observed pulse, both disappearing simultaneously. Disappearance of muscle contraction in those experiments where the nerve was not removed from the animal also occurred simultaneously with the disappearance of both pulses. With the use of stimulus voltages below that required to give a maximum electrical action pulse the percentage decrease below the maximum impulse detected electrically exactly paralleled the decrease in the electromagnetically detected impulse. Continued stimulation of inactive nerves gave only the stimulus artifact; no neuron action pulse could be observed electrically or electromagnetically.

Finally, mechanical stimulation by crushing an intact portion of an isolated nerve in the ungrounded plastic container gave single transient electromagnetic impulses visually equivalent to those obtained by electrical stimulation. These transient pulses could not be photographed because of the rapid trace decay of the oscilloscope phosphor.

## Discussion

There can be no doubt that this field exists, is an inescapable component of neuron activity, and must be of sufficient magnitude to be readily measureable since it could be detectable using relatively simple equipment. The experiments of Burr and Mauro [1] demonstrating the existence of an electrostatic field about an isolated frog sciatic nerve immediately confirms the existence of the electromagnetic field. Both fields are component vectors of the inductive field surrounding the actively conducting nerve, arise simultaneously, and are interdependent. Thus neuron impulses fellow the same laws applicable to moving charges as other phenomena and have the same inductive fields as those accompanying moving charges in general.

Detailed discussion of the theoretical and practical implications of the existence of these fields will be held for future publications. However, it should be noted that by proper measurement of these fields a method of localizing and mapping central nervous system activity is feasible without direct contact with the structure investigated, thus avoiding the trauma and artifact caused by the present contact methods.

## Summary

The electromagnetic field associated with neuronal activity is demonstrated for the first time and affords a new method for the study of the nervous system that avoids direct instrumentation.

# Educational Activities of Washington Scientists

JOHN K. TAYLOR
*Director, Science Projects*
*Joint Board on Science Education*

One of the distinguishing characteristics of a learned profession is the desire of its members to perpetuate it by fostering high educational standards and by attracting talented young people into its ranks. Washington area scientists as individuals have long been aware of this professional responsibility. Collective action in this respect has been of recent origin, however.

The first major cooperation of the scientific community with local educational programs was brought about by the advent of the science fair activities in 1947. Local educators found that they needed scientists and engineers in considerable numbers to serve as judges and counselors for student projects and appealed to the technical societies for assistance. In serving in these capacities, scientists became keenly aware of the part that they could play in cooperation with the schools to improve and strengthen science education, particularly at the secondary level.

As a result of these experiences, scientists and engineers reported back to their technical societies the need and opportunity for service. Apparently, their selling was effective for there was a sudden mushrooming of society-sponsored educational activities. Indeed the uncoordinated efforts that followed bordered on the side of chaotic in extreme cases. Accordingly, it became clear that some mechanism must be found for better utilization of these community resources. The D. C. Council of Engineering and Architectural Societies took positive action by establishing a school contacts committee with a member designated for each school to serve as liaison between it and the scientific community. The wisdom of this procedure has been proven by the fact that the school contacts program is today a major factor in science-education activities.

### Joint Board Established

As a result of the success of the above program, the need was estabished for a permanent organization to administer cooperative educational activities. After careful study by science education leaders of the D. C. Council and the Academy, the Joint Board on Science Education for the Greater Washington Area was formed in 1955 under joint sponsorship of the two groups for the purpose of "assisting and counseling the faculties of schools and related organizations, with power to initiate action, where desirable, and to raise funds to carry out the various activities of the Board."

The Board's program has evolved and expanded from the original school contacts activity to include a number of endeavors with an annual combined budget of about $7,500. One of the first of these was the project in which some 1000 scientists and engineers replaced class-room teachers to permit them to attend the annual meeting of the National Science Teachers Association which convened in Washington during March, 1956. This is the first known instance of a major cooperative effort between schools and scientists of the community and it aroused national attention. This activity has been repeated several times in this area, however on a smaller scale.

The science fair movement has grown to such an extent in this locality that most

of the schools now participate. As a result, the one area-wide fair has been replaced by five local area fairs, each affiliated with the National Science Fair-International. The Joint Board assists each of these by providing publicity material, entrance blanks, and other printed matter. (The Junior Academy of Sciences which is also a co-sponsor provides the major awards for each fair). The Joint Board also provides the transportation and expenses of the student-finalists and their teacher escorts to participate in the annual National Science Fair-International.

On becoming aware of the need for better communication between the educational and scientific communities, the Joint Board established a newsletter in 1958. This 8-page publication, known as THE REPORTER, appears monthly during the school year and is sent without charge to every teacher of science and mathematics in each of the junior and senior high schools of the Greater Washington Area. School contact persons and others interested in science education are also included in the monthly circulation of over 2000 copies.

A recent project of the Joint Board has been the publication of a book containing many suggestions for science projects. Scientists and engineers of this area were invited to outline projects, particularly those involving research or investigation on the part of the student. These contributions were edited by the writer, in collaboration with Dr. Phoebe Knipling and Dr. Falconer Smith and the resulting "Project Ideas for Young Scientists" was published in September 1960. a grant from the Eugene and Agnes E. Meyer Foundation made it possible to place a free copy of this book in the library of each secondary school in the area and to sell copies at a nominal price.*

**National Science Foundation Projects**

In 1959, the Washington Academy of Sciences received a grant of $35,000 from the National Science Foundation to make its science-education program more effective. The Joint Board became the logical body to administer this activity. With the writer as Director and Dr. William T. Read as Executive Secretary, four projects were developed and carried on. These may be summarized as follows:

Project I. To establish a community consultation service, including a roster of scientists and engineers willing to assist in educational activities.

Project II. To sponsor and participate in experimental educational programs concerned with better coordination of science and mathematics teaching in secondary schools.

Project III. To sponsor and participate in experimental educational programs concerned with better coordination of science and mathematics teaching in elementary schools.

Project IV. To sponsor conferences of school teachers and officials, university and college instructors, and scientists and engineers to consider problems concerned with science and mathematics teaching.

Details of the first year of this program and an evaluation of the results obtained are contained in the annual report submitted to the National Science Foundation on July 15, 1960. A limited number of copies are available for distribution and may be obtained by request to the office of the Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D. C.

The National Science Foundation has made another grant of $35,000 to the Academy to continue this program during 1960-61. Administrative details will be the

* Copies are available from the office of the Joint Board on Science Education, 1530 P Street, N.W., Washington 5, D. C., at $1.25 per copy.

same as during the previous year except that Mr. G. Gravatt Coleman, an engineer with the Chesapeake and Potomac Telephone Company, has replaced Dr. Read as Executive Secretary.

In addition to continuing the projects of the previous year, a special effort will be made to increase the usefulness of the roster of the scientists and engineers. Under the title, "Visiting Scientists and Engineers," a brochure has been published which lists over 100 lectures, many illustrated and containing demonstrations, that local scientists and engineers are willing to present to school groups. It is expected that school contacts will assist teachers in selecting subjects from this list that would be most helpful in a given situation. The office of the Joint Board will assist in making arrangements.

**More Help Needed**

Although several hundred persons are engaged in some phase of these educational activities, there is a need for more participants. The Joint Board serves the counties of Calvert, Charles, Montgomery, Prince Georges, and St. Mary's in Maryland and the counties of Arlington, Fairfax, and Prince William, and the cities of Alexandria and Falls Church in Virginia, as well as the District of Columbia. Private and parochial schools are included in the approximately 170 junior and senior high schools in this territory. Accordingly, the roster of scientists and engineers must be extensive and represent a large geographical area to be useful. Interested scientists are invited to register with the office of the Joint Board.

There is a special need for persons willing to assist in the administrative details of the program and also with editorial assignments.

# Science in Washington

## SCIENTISTS IN THE NEWS

*This column will present brief items concerning the activities of members of the Academy. Such items may include notices of talks given, important conferences or visits, promotions, awards, election to membership or office in scientific and technical societies, appointment to technical committees, civic activities, and marriages, births, and other family news. Formal contributors are being assigned for the systematic collection of news at institutions employing considerable numbers of Academy members (see list on masthead). However, for the bulk of the membership, we must rely on individuals to send us news concerning themselves, and their friends. Contributions may be addressed to* **S. B. Detwiler, Jr., Associate Editor, 2605 S. 8th St., Arlington, Va.**

APPLIED PHYSICS LABORATORY

**Albert M. Stone,** technical assistant to the directory, represented APL at the Twelfth General Assembly of the International Union of Geodesy and Geophysics, held July 25-August 6 in Helsinki.

**Archie I. Mahan** served as program chairman for the annual meeting of the Optical Society of America, held in Washington last spring. Dr. Mahan has been elected to a six-year term as associate editor of the Society's *Journal.*

CARNEGIE INSTITUTION OF WASHINGTON

**Philip H. Abelson,** director of the Institution's Geophysical Laboratory and president-elect of the Washington Academy of Sciences, has been made a member of the General Advisory Committee of the Atomic Energy Commission. The appointment was approved by President Eisenhower as of June 29. Dr. Abelson, an early pioneer in atomic energy, was the first scientist in this country to identify uranium fission products; with Edwin MacMillan he discovered neptunium. During World War II he designed and developed a method for uranium isotope separation that was used at Oak Ridge; subsequently he was involved in the first report indicating the feasibility of an atomic submarine.

COAST AND GEODETIC SURVEY

**Norman F. Braaten, Donald A. Rice, El-**

**liott B. Roberts,** and **Charles A. Whitten** attended the Twelfth General Assembly of the International Union of Geodesy and Geophysics, held July 25-August 6 in Helsinki. Mr. Whitten was elected president of the International Association of Geodesy, to serve for the three-year period 1960-63. Mr. Rice was elected chairman of the IAG's Gravimetry Section.

**Thomas J. Hickley,** chief of the Instrument Division, recently returned from a six-week trip to Europe, where he inspected hydrographic, oceanographic, and geophysical instruments at institutions in England, Germany, and Sweden.

**Barry G. Knapp,** son of David G. Knapp and a 1960 graduate of Montgomery-Blair High School, has been awarded a scholarship at Johns Hopkins University for studies in the physical sciences and engineering.

GEORGETOWN UNIVERSITY

The promotion of **Walter C. Hess** to associate dean of the Georgetown University Medical Center Schools of Medicine and Dentistry was announced September 10 by the Very Reverend Edward B. Bunn, S.J., president of the University. Previously, Dr. Hess had served as professor of biochemistry and assistant dean for research at the Medical Center.

NAS-NRC

On June 1, **George A. Llano** left his position with the Commission on Polar Research to become science specialist in biology in the Science and Technology Division, Library of Congress.

Effective July 1, **W. H. Larrimer** has been appointed executive secretary of a new NAS-NRC Committee on Pest Control and Wildlife Relationships in the Division of Biology and Agriculture.

**Linn Hoover,** on a year's leave of absence from Geological Survey, has been named executive secretary of the Division of Earth Sciences, effective July 1. The last permanent appointee to this post was William R. Thurston, who transferred to Geological Survey in May 1959, but continued to assist the Division until March 1960, when Adrian Richards was temporarily detailed to the position from the Navy's Hydrographic Office.

At the end of August, **Frank L. Campbell,** executive secretary of the Division of Biology and Agriculture, attended the annual meetings of the American Institute of Biological Sciences, held at Stillwater, Okla.

NATIONAL BUREAU OF STANDARDS

**Fred L. Mohler** retired August 1 as chief of the Mass Spectrometry Section, after 43 years with the Bureau. Dr. Mohler joined the Atomic Physics Section in 1917, just after receiving the Ph.D. degree in physics from Johns Hopkins, and was made chief of the Section in 1928; during this period, he worked on fundamental phenomena in atomic physics, including electrical discharges in gases, the study of ionization potentials, and ionization of liquids. After service in World War II with the Ninth Air Force in Europe, and a year with the Manhattan Project, Dr. Mohler was appointed to head the Mass Spectrometry Section, where he has been engaged in the development of mass spectrometric methods as applied to chemical and isotope analysis and molecular physics.

**Harold F. Stimson,** a senior physicist in the Temperature Physics Section, retired April 30 after more than 42 years with the Bureau. Dr. Stimson joined the staff in 1916 after receiving the Ph.D. degree from Clark University. He has pioneered many scientific advances in the field of heat measurement, and is recognized as one of the world's foremost authorities on the International Temperature Scale. His activities have included important research on the accurate determination of the thermal properties of water and steam, as part of an international program for the production of steam tables to be used as a basis for engineering and power plant design. As a member of the Advisory Committee on Thermometry, he played a major role in drafting the International Temperature Scale of 1948; and he has recently completed work on a text revision which may be adopted at the 1960 meeting of the General Conference on Weights and Measures.

**Hubert R. Snoke** retired July 31 as assistant chief of the Building Technology Division, after over 40 years of service. A graduate of Lebanon Valley College, Dr. Snoke joined the staff as a chemist in the Chemistry Division's Paint Laboratory. Since 1929 he has specialized in bituminous and other roofing materials, and is an internationally-recognized authority in the field. When the Building Technology Division was formed in 1947, Dr. Snoke was named to head the Floor, Roof, and Wall Coverings Section; and in 1956 he was assigned concurrent duties as assistant chief of Division. Lebanon Valley awarded him the honorary D.Sc degree in 1952.

**Archibald T. McPherson** was guest of honor at a reception and dinner held May 24 at the Army-Navy Club by the Washington Chapter, American Institute of Chemists. Dr. McPherson was awarded the Chapter's 1960 Honor Scroll.

**Kurt E. Shuler,** an authority in the fields of chemical kinetics, statistical mechanics, energy transfer, and molecular spectroscopy, has been appointed consultant to the director. In this capacity he will advise on the Bureau's continuing efforts to strengthen its basic science program. Dr. Shuler will at the same time continue his own research in chemical physics.

The following Academy members are among the Bureau scientists who recently received Department of Commerce awards for outstanding accomplishment: Gold Medal for Exceptional Service, to **Chester H. Page,** consultant to the director and chief of the Electricity Division, for

contributions in electronics, ordnance, and physical research and measurement; **Herbert P. Broida,** technical coordinator of free radicals research, and **Arnold M. Bass,** chief of the Free Radicals Section, for leadership in the direction of the Bureau's free radicals program; and **Charlotte Moore-Sitterly** of the Spectroscopy Section, for research in spectroscopy and astrophysics. Silver Medal for Meritorious Service, to **John K. Taylor,** for contributions to accurate electrochemical methods of analysis; and **Hugh L. Logan** of the Corrosion Section, for research on stress-corrosion cracking of metals.

NATIONAL INSTITUTES OF HEALTH

**Kenneth S. Cole,** chief of the Biophysics Laboratory, National Institute of Neurological Diseases and Blindness, recently returned from a five-week visit to European laboratories that are conducting research on electrical potentials in nerve fibers. He discussed results of continuing work on ionic membrane currents with authorities in Paris, Stockholm, Uppsala, London, and Cambridge. Dr. Cole spent most of his time at Uppsala University, where he discussed comparative results of analogue computer studies of clamped nerve fibers with Torsten Teorell.

NAVAL RESEARCH LABORATORY

**Peter King,** associate director of research for materials, was awarded the Navy's Distinguished Civilian Service award in ceremonies on May 31. Dr. King was honored for outstanding achievement in contributing to the development and direction of a Long Range Detection Program which led to conclusive evidence of the first atomic explosion by a foreign power. The analytical system developed by Dr. King identified the bomb material and fixed the approximate time of the explosion. His final chemical analysis for the fissionable material revealed the advanced state of technology of the foreign power concerned.

**George R. Irwin,** superintendent of the Mechanics Division, received the Charles B. Dudley Medal of the American Society for Testing Materials on June 29, at the Society's annual meeting in Atlantic City. This award is "presented for a paper of outstanding merit constituting an original contribution on research in engineering materials." The paper, entitled "Fracture Strengths Relative to Onset and Arrest of Crack Propagation," was published in *ASTM Proceedings 58,* 640 (1958).

Dr. Irwin also has received the NRL-RESA Award for Applied Science for 1960, which was presented in ceremonies on May 10. The award was given for his studies in the theory of fracture failure in metals.

USDA, BELTSVILLE

**Kermit W. Kreitlow,** Crops Research Division, was chairman of the Herbage Disease Section at the Eighth International Grassland Congress, held July 11-21 at Reading, England. In conjunction with the Congress, Dr. Kreitlow visited a number of European laboratories where diseases of forage grasses and legumes are being investigated.

**Erwin L. LeClerg,** director of Biometrical Services, Agricultural Research Service, was a recent honor guest at ceremonies on the Colorado State University campus, where he received the Honor Alumnus Professional Achievement Award.

**Edward F. Knipling,** director of the Entomology Research Division, ARS, was a co-winner of this year's Hoblitzelle National Award in the Agricultural Sciences for his part in developing a new method of fighting insect pests with atomic energy. The other recipient was **Raymond C. Bushland** of the Department's entomology laboratory at Kerryville, Tex. The two scientists received the award—$10,000 and a gold medal—for their part in developing the use of male screwworm flies, made sterile by exposure to radioactive cobalt-60, to eradicate the screwworm, a serious pest of cattle.

Dr. Knipling also received a Distinguished Service Award at the USDA Honor Awards Ceremony on May 17.

USDA, WASHINGTON

**Kenneth W. Parker** attended the Eighth International Grassland Congress at Reading, England, July 11-21, as a representative of USDA; he subsequently traveled in Bavaria, France, and Spain to observe range and wildlife habitat management on high mountain rangelands. Dr. Parker was scheduled to present an invited paper, "Principles of Grazing Management as Related to Vegetation Condition and Soil Stability," at the Fifth World Forestry Congress, held at Seattle on the University of Washington campus, August 29-September 10.

**Harold H. Shepard** last June led a Soviet exchange team of six specialists in fertilizers, insecticides, and other agricultural chemicals on a 20-day tour of United States facilities conducting research in the field. The group met with Federal, state, and industrial workers in six states as well as the Washington, D. C., area.

**Justus C. Ward** spoke on "Federal Pesticide Laws and Sanitation" before the Indiana Association of Sanitarians, meeting June 9 at Indianapolis. On August 14 he spoke on "Toxicology and Federal Pesticide Control" before the American College of Veterinary Toxicology at Denver.

**Harold T. Cook** attended the Institute of Food Technology's Pacific Rim Food Conference, held May 19-29 in Hawaii. Dr. Cook was chairman of the Section on Tropical Fruit and Spice Products.

At the USDA Honor Awards Ceremony on May 17, **Herbert L. J. Haller** received the Distinguished Service Award, while **Elbert L. Little** and **Harold H. Shepard** received Superior Service Awards.

**Hazel K. Stiebeling** was a member of the organizing committee and chairman of the publications subcommittee for the Fifth International Congress on Nutrition, meeting in Washington September 1-7. She also was co-chairman of one of the sessions at which original research papers relating to human nutrition were presented.

UNCLASSIFIED

**Ward Pigman** has been appointed professor and chairman of the Department of Biochemistry at New York Medical College, effective September 1. Dr. Pigman was formerly associate professor of biochemistry at the University of Alabama Medical College.

Six Academy members attended the 21st International Geological Congress, held August 15-25 at Copenhagen. They are **George T. Faust, Edwin W. Rodder,** and **Clarence S. Ross,** of the Geological Survey; **Waldmar T. Schaller,** retired; **William W. Rubey,** former WAS president, now located at the Institute of Geophysics, UCLA; and **James Gilluly,** who is currently retiring from a Geological Survey post at Denver.

DEATHS

**Ernest L. Jackson,** retired former chemist at the National Institutes of Health who was noted for his contributions to the chemistry of carbohydrates, died of cancer on June 14 at the NIH Clinical Center, after a long illness. He was 68.

Dr. Jackson received his doctorate at Harvard University. After teaching at Western Reserve and Emory Universities, he joined the staff of the Public Health Service in 1928. His early work included the discovery and pioneer development of a technique for the periodic acid oxidation of sugars, considered one of the most valuable tools for structure determination ever devised in sugar chemistry. He also worked on the development of chemo-therapeutic agents for use against tuberculosis, and on the synthesis and structure of antibacterial agents. During recent years, Dr. Jackson investigated various approaches to the synthesis of an analogue of thyroxine in which the ether bridge is in the meta position to the alanine side chain. He retired from NIH two years ago, but remained active by writing articles for professional journals.

**Howard A. Edson,** a resident member of the Academy, died February 29, 1960. Dr. Edson was elected to the Academy in 1921 from the field of plant pathology, and retired in 1946.

**Carroll E. Cox** of the Botany Department, University of Maryland, died June 24. In 1959, Dr. Cox represented the Botanical Society of Washington on the Academy's Board of Managers.

## AFFILIATED SOCIETIES

**Chemical Society of Washington**

*President:* Allen L. Alexander (NRL). *Secretary:* John L. Torgesen (NBS).

The Board of Managers met on May 3 at the American Chemical Society Building, with President Alexander presiding. The minutes of the March 1 meeting were read and approved. The treasurer's report for the period January 4-May 2 was distributed.

A proposal that the Society's working name be changed from "Washington Section" (of the American Chemical Society) to "National Capital Section" was considered by the Board and defeated.

Frank S. Grimaldi reported for the Education Committee that ten chemistry winners in the recent Science Fairs, and their teachers, would be dinner guests of the Society at its May 6 "meeting-in-miniature." John M. Leonard reported that a total of $1600 had been provided by the Society, the Washington Academy of Sciences, and the Junior Academy, for use as lunch money and carfare for high school students working in Washington-area laboratories during the summer. Up to the time of the meeting, 21 student applications had been received.

John K. Taylor reported for the Professional Relations and Status Committee, that plans were under way to devote one of the regular meetings of the Society to a panel discussion of such a topic as "Improving the Status of Chemists." He also reported that the Committee was exploring the establishment of an employment service for local chemists.

William J. Bailey of the Programs Committee circulated the program for the May 6 "meeting-in-miniature" to be held jointly with the Maryland Section of ACS; this showed a total of 53 papers to be presented at afternoon and evening sessions of six divisions.

Chairman Andrew F. Freeman of the Membership Committee reported on collaboration with THE CAPITAL CHEMIST in preparation of the classified membership list for the annual Directory. Mr. Freeman also urged that membership applications originating in the area be sent to the ACS through the Membership Committee, so that commissions might be properly credited to the local Society.

An *ad hoc* Committee on Member Interest, appointed at the Board's March 1 meeting, reported on a study of annual reports of other ACS local sections, with the findings that (1) the number of people who help to govern the affairs of the sections is in direct proportion to the number of active members, and (2) the proportion of committee members is greater in the more active sections than in the Chemical Society of Washington. At the Committee's recommendation, the Board agreed to the appointment of a new *ad hoc* Committee on Member Participation, charged with making a survey of special talents among the membership, and with determining the members' interest in participating in ACS activities.

# THE BROWNSTONE TOWER

FRANK L. CAMPBELL

In the issue of June 1948 of the late *Scientific Monthly* appeared the last column called "The Brownstone Tower." It had run through 42 issues of the *Monthly* and terminated only because we moved on to other work. As a memento we took with us the cut of the Smithsonian's principal tower, the brownstone tower, on the eighth floor of which behind the clock face we had written the earlier columns. We had never expected to use it again, but here it is and it seems even more appropriate in this journal about science and scientists in Washington than it did in the old *Scientific Monthly*.

And now we are off again on our observational rambles, promising nothing, but hoping that the new Brownstone Tower will help to broaden the view of professional and amateur scientists in Washington.

We have just returned from the 11th annual meeting of the American Institute of Biological Sciences at the Oklahoma State University in Stillwater. The AIBS is a federation of national biological societies, some of which hold their annual meetings under the auspices of the Institute, always on a university campus. These societies are affiliated not only with AIBS but with the National Academy of Sciences—National Research Council and the American Association for the Advancement of Science. We represent NAS-NRC at the AIBS meetings and Raymond Taylor the AAAS. Thus we are interested both in the individual socieities and in the AIBS itself.

Our experience in Stillwater and at seven previous meetings of AIBS leads us to reflect on organizational differences between biology and chemistry, to the advantage of the latter. Chemistry is unified in its nomenclature, and in its educational and organizational arrangements. Every scientist who deals with transformations of non-living matter can and usually does call himself a chemist. If he is a pure chemist, he may think of himself as an inorganic chemist, organic chemist, analytical chemist, electrochemist, etc. If he works in applied chemistry he may be a rubber chemist, petroleum chemist, textile chemist, insecticide chemist, etc.—the name is always "chemist" with suitable modification. In institutions of higher education he prepares for his profession in departments of chemistry and when he is ready for membership in a professional society, he becomes a member of the American Chemical Society. All along the line "chemist," "chemistry," and "chemical" prevail and the chemical chorus before other scientists and the lay public is clear and strong.

What a contrast is found among scientists who study living and dead organisms, excluding man! They all could be called biologists with suitable modifiers to express the area of biology in which they work, but unfortunately they did not provide for the unity so characteristic of and helpful to the chemical profession. There is no harmonious chorus as yet and there may never be anything like the chemical chorus among those who would call themselves biologists but do not. Specialists in biology use many names; e.g., botanist, ecologist, embryo'ogist, entomologist, geneticist, mycologist, physiologist, zoologist, etc., etc. In applied biology we have agronomist, animal husbandman, forester, horticulturalist, plant breeder, plant pathologist, poultry scientist, veterinarian, etc., etc. Furthermore, we have university departments of agronomy, animal husbandry, bacteriology, botany, entomology, physiology, plant pathology, zoology, etc., and various combinations of these. And when majors in these departments are ready for membership in professional society they join one or more of the societies concerned with or related to the field of their specialization. For example, a man who takes his degree in agronomy does not become an agronomical biologist and join an American Biological Society; he becomes an agronomist and joins the American Society of Agronomy. Thereafter, he thinks of himself only as an agronomist and if he is a loyal member of his society, he thinks only in terms of the advancement of agronomy through his society. Although quite aware of soil science and less conscious of other branches of biology round about, such as horticulture, plant physiology and plant patholgy, to him agronomy alone is really important. This narrow outlook is not restricted to agronomists; it is prevalent among foresters, horticulturalists, entomologists, plant pathologists and other applied biological scientists. To a lesser extent it is found among botanists, geneticists, zoologists, etc.

The interphase between biology and mathematics, physics, and chemistry has been delivered to the last three disciplines through the currently accepted nomenclature, biometrics, biophysics biochemistry—never statistical biology, or physical biology, or chemical biology. And as between chemistry and physics, chemistry wins with "physical chemistry."

And so it is that biology next to mathematics, physics, and chemistry has become "et cetera." But through AIBS biology is moving toward useful unification through the federation of existing biological societies.

## ACADEMY ACTIVITIES

**Board of Managers, May Meeting**

These notes are intended to outline briefly, for the information of the membership, the principal actions taken at Board meetings. They are not the official Minutes as prepared by the Secretary. —Ed.

The Board of Managers held its 529th meeting on May 17 at NBS, with President Wood presiding.

The minutes of the 528th meeting, previously circulated, were approved with minor changes.

Dr. Wood announced the appointment of new members of the Committee on Policy and Planning. The complete roster of the Committee is: Through 1960, F. M. Setzler and J. E. P. Morrison; through 1961, W. Schmidt and P. D. Foote; through 1962, A T. McPherson (chairman) and A. M. Sookne.

Dr. Wood also announced the complete roster of the Committee on Science Education, as follows: Through mid-1961, R. J. Seeger (chairman) and F. Smith; through mid-1962, H. A. Meyerhoff and J. K. Taylor; through mid-1963, J. A. Sanderson and L. Schubert. Dr. Wood observed that the Committee members are also the Academy representatives on the Joint Board on Science Education, and that its business largely concerns the Joint Board; however, as a Committee it may bring before the Academy other matters considered germane to science education.

Dr. Stiehler, reporting for the Meetings Committee, initiated a general discussion concerned with the development of programs that would stimulate increased attendance at the Academy's general meetings. It was noted that the Philosophical Society has had excellent attendance at its meetings, despite the fact that its membership is no larger than that of the Academy. The desirability of holding joint meetings with the Academy's affiliates was discussed at length, with an essentially negative reaction. Dr. Wood suggested that the Academy membership at large might very desirably assist the Meetings Committee by offering ideas on speakers for future programs.

Chairman Hall of the Membership Committee presented, for first reading, the names of 11 candidates for membership. Dr. Wood indicated that these nominations would be voted upon at the June meeting.

Mrs. Fell reported on sales by Pergamon Press of the Academy's monograph on microsomal particles. She indicated that as of April 30 about 500 copies had been sold in New York and 400 in London, and that 1061 copies in all could be accounted for. According to the contract with Pergamon, royalties will accrue to the Academy only after 1500 copies have been sold.

Chairman McPherson of the Policy and Planning Committee called attention to the Board's request in November 1959, that the Committee should study the current relationship between the Academy and its affiliated societies, with a view to determining whether some societies might wish to sever relations. Dr. McPherson asked permission to expand this instruction, as follows: "The Policy and Planning Committee is requested to study the relations of the Academy with its affiliated societies to determine ways and means whereby (1) these relations can be extended and made closer to the mutual benefit of the affiliated societies and the Academy; (2) the Academy can provide a larger measure of leadership in the activities of the scientific community; (3) the affiliated societies whose aims, objectives, and interests are no longer consistent with those of the Academy can be tactfully induced to sever relations with the Academy." The Board agreed to this language.

Chairman Schubert of the Committee on Encouragement of Science Talent reported that he had met with Watson Davis and others concerned with national science fairs, concerning the criticisms of these fairs that had been raised at previous meetings of the WAS Board. Dr. Davis appeared to be in agreement with the concept of state science fairs, and to feel that national science fairs are giving inadequate returns on the expense involved; also, he felt that it is necessary to develop new rules for the conduct of local science fairs.

Dr. Schubert also reported that the Joint Board has carefully considered, and was preparing a response to, the letter transmitted some months ago by Dr. Robbins for the Society of American Bacteriologists, on improved rules for the development of science fair exhibits.

Dr. Hall presented for second reading the names of eight candidates previously proposed for Academy membership, as follows: G. Robert Coatney, Helen L. Garstens, Warren W. Hastings, Jack C. Jones, Robert C. Likins, Geoffrey S. S. Ludford, Meyer Rubin, and Emma Shelton. These candidates were then elected to membership.

## SCIENCE AND DEVELOPMENT

**The tornado is one of the most dangerous of all storms.** The deadly funnel dips suddenly from a cumulo-nimbus cloud to spread its destruction, often over a very small area. The possibility that a meteorological satellite orbiting some 400 miles above the earth would photograph an isolated mass of tornado-producing clouds seems remote; yet Weather Bureau scientists believe that NASA's satellite TIROS I did just that, last

May 19. During a painstaking analysis of over 20,000 photograpns taken by TIROS, the Bureau's satellite meteorologists discovered a striking and unusual picture that showed an isolated group of clouds appearing in the photograph as a very bright square in an otherwise cloudless part of the sky. A subsequent analysis showed that the "square" cloud mass was precisely in the area of heavy thunderstorm activity reported by the Texas cities of Hobart, Childress, and Wichita Falls at the exact time the TIROS wide-angle camera snapped the picture. The analysis also produced strong evidence that this cloud mass later expanded and spread northeastward, spawning tornadoes and hail in central Oklahoma.

**The NIH *Record* has provided the following idea of the relative pain-killing power of analgesic drugs** by rating them, on the basis of equivalent doses, on a numerical scale, assigning to morphine the value of 100: 500-1,000—phenazocine (NIH-7519) and 14-hydroxydihydromorphinone (Numorphan); 500—levophan (Dromoran); 300-400 — dihydromorphinone (Dilaudid) and metopon; 300—heroin; 100-morphine and methadone (Dolophine); 80-90—dihydrohydroxycodeinone (Eucodal); 30-50—anileridine (Leritine) and diethylthiambutene (Themalon); 20-30—meperidine (Demerol); 15—codeine; and 1-2—aspirin. Aspirin actually does not belong with the other drugs, but is inserted for comparison. All of the drugs are addicting to some degree with the exception of aspirin, which definitely is not. Heroin, although listed above, is not used in medical practice in the United States; it has been banned because of its high rate of abuse as an addicting drug.

**A marvel in fish obstetrics—a pregnant female shark containing 114 embryos each about 10 inches long—has been reported by the Division of Fishes of the Smithsonian Institution.** The total mass of embryos amounted to about 5 gallons, probably a record for fish. The specimen, belonging to a species of bramble shark, was received from the Hawaiian Islands in connection with a world-wide census of shark attacks now being conducted under Institution auspices. Although formidable in appearance—the body is covered with short, sharp spines—this shark is not considered dangerous to humans, since it is a bottom dweller in deep water and seldom comes near the surface.

**NBS has developed an improved scanning photometer to determine wavelengths of spectral lines on a spectrographic plate** easily, rapidly, and accurately. The instrument, devised by M. L. Kuder of the Bureau's Electronic Instrumentation Laboratory, optically scans a 0.5-mm-wide portion of the plate and then presents, on an oscilloscope tube, a curve of spectral line density versus wavelength. The instrument was developed for the Bureau's Spectroscopic Laboratory to help automate the processing of a large volume of spectrographic plates.

**The Coast and Geodetic Survey issues regular press releases to report the activities of its numerous triangulation survey parties that range the country,** establishing accurate base points that are used in mapmaking, engineering projects, local surveying, etc. Each press release contains an interesting stock statement that appears intended to quash superstitious rumors before they can get started. The statement generally reads as follows:

> "Someday you may suddenly notice a slender steel tower silhouetted against the skyline, or at night the blinking of lights in Morse code may catch your eye. These strange sights coupled with the busy movement of men and trucks may cause some of the local residents particular concern. Though unfamiliar to the area, these sights are actually part of one of the oldest operations carried on by the Federal Government, that is, to survey accurately all of the land area within our borders. The towers are not used in drilling for oil, and the strange lights are not some mysterious secret code.
>
> "The activities are merely the work of a Coast and Geodetic Survey field party. This party is one of several similar parties that methodically roam the country, in a nomadic way of life, from the Great Lakes to the Gulf and from the Atlantic to the Pacific. Their summer schedule finds them working the northern states and gradually moving south with the sun. Thus these men perform the geodetic work of the Survey."

**The Geological Survey has completed a terrain study of the moon for the Army Engineer Corps,** to provide lunar surface information for selecting landing sites, and as an aid in designing telemetering instruments and a lunar surface vehicle. The study consists of three diagrams, all of which show the visible face of the moon at a diameter of 36 inches, and an accompanying brief text. One diagram shows the physiographic regions of the moon; the second diagram is a general photogeologic map of the moon, showing relative ages of the various craters and maria; and the third diagram depicts the prominent lunar rays, which are interpreted as splashes of crushed rock derived from the impact of large fragments thrown out at times of meteoric impact.

**A program for the reporting of unusual or adverse reactions to drugs was announced in May by the Food and Drug Administration.** To be conducted initially with a limited number of hospitals selected to represent a cross-section of medical specialties, the program is designed to develop information promptly on the untoward effects of drugs, especially the newer

drugs; the information will be used by FDA in the resolution of medical and administrative problems under the Food, Drug, and Cosmetic Act. The project is an outgrowth of a voluntary pilot study carried out during the past four years in cooperation with the American Association of Medical Record Librarians, the American Society of Hospital Pharmacists, the American Medical Association, and the American Hospital Association.

**Federal support to the nation's leading oceanographers in an international expedition to the Indian Ocean** was announced last June by the White House. The expedition, a scientific project of extraordinary scope and magnitude, will begin late this year and extend through 1964. Like the recent International Geophysical Year, the International Indian Ocean Expedition will incorporate a many-sided scientific attack on a single area of interest under the leadership of a special committee of the International Council of Scientific Unions. Scientific responsibility for U. S. participation is vested in NAS-NRC. Key financial contributions will be made by the Navy Department and the National Science Foundation.

**Vast, isolated islands in the sky, the largest about 2,500 square miles in area, are the flat, green tops of the sandstone massifs which constitute the Guayana Highlands of northeastern South America.** An account of these islands was recently presented at a Smithsonian staff seminar by John J. Wurdack, who explored them for the New York Botanical Garden. He reports that some of them are almost two miles high, and are cold, rainy, desolate regions, swept constantly by penetrating, wet winds; they are almost devoid of animal life, except for birds. The canyon of one mountain, Cerro Neblina, is deeper than any gorge in the United States. Man, except for a few hardy explorers, has never attained most of the summits. Seen from above, large portions of the surfaces appear to be level, treeless green plains; actually these are peat bogs in which one may sink to the ankles. One flyer who landed safely enough was forced to abandon his plane, which is still there, sinking slowly into the bog.

**The Coast and Geodetic Survey in July began a 1500-mile shoreline survey of Chesapeake Bay,** in cooperation with the Maryland Department of Tidewater Fisheries. The project will provide 37 special shoreline maps for the Maryland agency in its study and development of seafood resources, especially oyster cultivation. In addition, C&GS will revise about 80 of its own large scale base maps of the Bay with the aerial photography and field data thus acquired. Both State and Federal governments will share the expense of this project, expected to cost about $120,000.

**A new index map of the United States has been published by the Geological Survey** covering small-scale maps in the 1:250,000-scale topographic map series. When completed, this series, covering all 50 States, will contain 626 maps, 437 of which are now available. Five show the eight principal islands in Hawaii. Alaska is covered by 153. Ninety-five have been completed during the past 15 months and 32 are in progress. All are expected to be available by late 1962 or early 1963.

**NBS has found that its parallel-testing interferometer, developed a few years ago by J. B. Saunders for measuring the parallelism of the opposite faces of gage blocks, can be used without modification to compare the lengths of such blocks.** This method has the advantage of not requiring wringing which, when repeatedly applied, can injure the surfaces of gage blocks to the extent that reworking is often necessary. Further, as blocks are measured in a horizontal position, use of the parallelism interferometer eliminates corrections for gravitational distortion in length measurements. Faster testing is another consequence of the technique, which makes it possible to measure blocks without handling, thus doing away with a major source of thermal disturbance.

**More than 5,000 "shooting stars" a year have been recorded authentically by competent observers over much of the world during the past half century.** Some 294,000 of these luminous bodies reported over the years 1901-1959 have been catalogued by Charles P. Oliver, director of the American Meteorological Society; results of this laborious task have just been published by Smithsonian's Astrophysical Observatory. The figures have been broken down into averages for months and hours of each night when reliable observations were possible. With a few notable exceptions, the monthly rates remained fairly constant throughout the 50-year period, but showed a tendency to increase in autumn and early winter, possibly because of better observing conditions. There also was a tendency to increase rather markedly toward the middle of each month and, in general, in hours just after midnight.

**The Optical Society of America now has an executive office in the new American Chemical Society Building at 1155 16th St., N.W.** Its publication, *Optics and Spectroscopy*, is a cover-to-cover translation of the Russian journal, *Optikaispektroskopiya;* OSA initiated this translation journal with the January 1959 issue (Vol. 6, No. 1).

**Studies made by the Geological Survey in the vicinity of Dulles International Airport at Chantilly, indicate ample water for construction needs but show it to be moderately**

**mineralized, very hard, and in need of treatment to make it suitable for domestic and some industrial uses.** Pumping tests of two wells drilled to 860 and 955 feet by contractors in the spring of 1959 indicate yields of 327 and 600 gallons per minute, which are very high for the red shale water-bearing formation penetrated. Previously no known well in the immediate vicinity was more than 180 feet deep or produced more than 12 gallons per minute.

**Continued belief in old wives' tales, magic potions, and old-fashioned home remedies** in the 20th century, enabled an enterprising promoter to stock more than a hundred herbs and offer them in packages labeled as specific "cures" for practically every human ailment. In July, Food and Drug Administration announced seizure of his "teas" and "tonics" for conditions including arthritis, asthma, change of life, diabetes, epilepsy, external cataracts, hardening of the arteries, heart trouble, kidney stones, overweight, tapeworms, and varicose veins. Also taken into custody were raw materials such as cramp bark, devil shoe string, dog grass, figwort, skunk cabbage, queen of the meadow, and turtlebloom. Misbranding charges were filed, based on false and misleading curative claims in the labeling.

**NAS-NRC has announced the formation of a new Committee on Pest Control—Wildlife Relationships,** to investigate the relationship between chemical control of agricultural pests and conservation of America's wildlife populations. Creation of the Committee, which will function within the Division of Biology and Agriculture, is most recent of several steps taken by the Academy-Research Council during the past few years in response to concern expressed in several quarters over use of chemicals to control agricultural pests. Committee chairman is Ira L. Baldwin, special assistant to the president of the University of Wisconsin.

**Three methods of removing radioactive contaminants from drinking water supplies have been successfully tested by the Army Engineer R&D Laboratories at Fort Belvoir.** These methods involve a standard purification unit consisting of chemical coagulation and diatomite filtration that the Engineers call an "Erdlator," a mobile ion exchange unit, and an electrodialysis demineralization process. In one of the tests, conducted at the Nevada Test Site, radioactive soil ground to simulate fallout was added to a water source to give a contamination level of 660,000 units (micro microcuries per liter). After treatment in the "Erdlator," the contamination was reduced to 5,000 units (300,000 units is considered a safe emergency drinking water tolerance).

**Chysanthemum stems can be greatly shortened by a new and relatively inexpensive plant-growth regulator,** according to USDA scientists at Beltsville. Growers may be able to use this chemical—"phosfon"—to advantage because short chrysanthemum plants require no staking. Flower size is not noticeably affected by phosfon. The flowers of treated plants last longer, and their leaves are dark green, as compared with the medium- to light-green leaf color of untreated plants.

## Vice-Presidents of the Washington Academy of Sciences Representing the Affiliated Societies

| | |
|---|---|
| Acoustical Society of America | Richard Cook |
| Institute of the Aeronautical Sciences | *Not Named.* |
| Anthropological Society of Washington | Regina Flannery |
| Society of American Bacteriologists | Mary Louise Robbins |
| Biological Society of Washington | Herbert Friedman |
| Society for Experimental Biology and Medicine | Kathryn Knowlton |
| Botanical Society of Washington | Herbert C. Hanson |
| Chemical Society of Washington | William J. Bailey |
| American Society of Civil Engineers | *Not Named.* |
| International Assn. for Dental Research | Gerhard Brauer |
| American Inst. of Electrical Engineers | Robert D. Elbourn |
| Washington Society of Engineers | Howard S. Rappleye |
| Entomological Society of Washington | Harold H. Shepard |
| Society of American Foresters | *Not Named.* |
| National Geographic Society | Alexander Wetmore |
| Geological Society of Washington | Carle Dane |
| Helminthological Society of Washington | Carlton M. Herman |
| Columbia Historical Society | U. S. Grant, III |
| Insecticide Society of Washington | Joseph Yuill |
| Amer. Society of Mechanical Engineers | William G. Allen |
| Medical Society of the Dist. of Columbia | Fred O. Coe |
| American Society for Metals | John A. Bennett |
| American Meteorological Society | Morris Tepper |
| Institute of Radio Engineers | Robert Huntoon |
| American Nuclear Society, Washington Section | Urner Liddel |
| Philosophical Society of Washington | Louis R. Maxwell |
| Society of American Military Engineers | *Not Named.* |

## Chairmen of Committees

### Standing Committees

| | |
|---|---|
| Executive | Lawrence A. Wood, *Nat. Bureau of Standards* |
| Meetings | Robert D. Stiehler, *Nat. Bureau of Standards* |
| Membership | Wayne C. Hall, *Naval Research Laboratory* |
| Monographs | Dean B. Cowie, *Dept. of Terrestrial Magnetism* |
| Awards for Scientific Achievement | Archie I. Mahan, *Applied Physics Laboratory* |
| Grants-in-Aid for Research | B. D. van Evera, *George Washington University* |
| Policy and Planning | A. T. McPherson, *Nat. Bureau of Standards* |
| Encouragement of Science Talent | Raymond J. Seeger, *Nat. Science Foundation* |

### Special Committees

| | |
|---|---|
| By Laws | Harold H. Shepard, *Dept. of Agriculture* |
| Library of Congress | John A. O'Keefe, *Nat. Aeronautics & Space Admin.* |
| Repres. on AAAS Council | Howard A. Meyerhoff, *Scientific Manpower Commission* |